

**National Park Service Vital Signs Monitoring Program
Coastal and Barrier Network
Estuarine Nutrient Enrichment Workgroup**

**Selection of Monitoring Variables
February 12, 2001**

Meeting Summary

Participants

Hilary Neckles, US Geological Survey
Charles Roman, US Geological Survey
Scott Nixon, University of Rhode Island
Norm Rubinstein, Environmental Protection Agency
Jim Latimer, Environmental Protection Agency
Veronica Berounsky, University of Rhode Island
Brian Sturgis, National Park Service-Assateague Island National Seashore

Overview of NPS Vital Signs Monitoring Program

The document “Park Vital Signs Monitoring: Vision and Implementation Plan” summarizes the goals and administration of NPS Vital Signs Monitoring Program. Monitoring programs will be applied within biogeographic networks of parks. The network structure was adopted as a realistic way to monitor natural resources at all parks nationwide with the funding available. This organization allows parks with similar natural resource characteristics to share costs of program development and implementation.

The Coastal and Barrier Network consists of 8 parks from Massachusetts to Virginia. The 5 largest parks (19,000-44,000 acres) include significant estuarine habitat: Cape Cod National Seashore, Assateague Island National Seashore, Gateway National Recreation Area (New York City vicinity), and Fire Island National Seashore. Colonial National Historic Park is a moderate-sized park (9000 acres) with 30 miles of shoreline along lower Chesapeake Bay. Two very small parks, Sagamore Hill National Historic Site (north shore of Long Island) and George Washington’s Birthplace National Monument (upper Chesapeake Bay) include short stretches of estuarine shoreline. The final park in the network, Thomas Stone National Historic Site (Maryland), has no estuarine habitat.

This network will receive \$720,000 this year, and \$957,000 annually thereafter, to develop and implement a natural resource monitoring program. This level of funding will not allow comprehensive monitoring at each park; it is intended to support a minimum, core program that can be supplemented with more intensive future efforts as required. Monitoring is focused on the information needed to manage park resources. The highest priority management issues within the Coastal and Barrier Network have been identified through previous meetings and workshops. Workgroups are drafting monitoring plans to address estuarine nutrient enrichment, freshwater nutrient enrichment, shoreline change, contaminants, visitor use and recreation,

animal species and habitats of special concern, and plant species and habitats of special concern. In addition, workgroups are drafting plans for overall program needs related to aerial photography, vegetation mapping, and data management. Ultimately, workgroup results will be consolidated into a single, integrated monitoring plan for the network.

Workgroups will recommend monitoring variables, spatial and temporal frequency of monitoring, and sampling methods. Other than obvious funding limitations, there are no *a priori* assumptions or restrictions on program design. For example, sampling could focus on a subset of management issues/monitoring variables at all parks in a given year, or could focus on all issues/variables at a subset of parks in a given year, etc.

Goals of Estuarine Nutrient Monitoring

The workgroup clarified the goals of monitoring estuarine nutrient enrichment. The purpose of monitoring is to inform and guide management decisions regarding protection of estuarine ecosystems. A monitoring program must address the following basic questions: 1) Are estuarine nutrient levels in network parks increasing? 2) Are estuarine resources in the parks changing in response to nutrient inputs? The monitoring program will be designed to focus on management issues. Ideally, monitoring would detect early changes in estuarine nutrient status and identify causes and consequences of those changes, so that remedial management actions could be developed as needed.

Monitoring variables may include direct measures of stressors (water quality constituents) or measures of ecosystem characteristics that serve as predictable indicators of nutrient enrichment.

Workgroup Product

The workgroup will select and prioritize candidate variables for monitoring estuarine nutrient enrichment. A graduate student at the University of Rhode Island, supervised by a member of the workgroup, will collate and summarize background information relevant to NPS monitoring. A synthesis report on candidate monitoring variables will be completed within nine months and will include the following information:

- Justification for monitoring nutrient effects on estuarine water quality, including conceptual model of nutrient inputs and ecosystem responses
- Evaluation of type of information needed from estuarine water quality monitoring program at individual parks, based on discussions with park natural resource managers
- Objectives for the monitoring program
- Summary of current or historical monitoring of estuarine water quality and related variables in each park, including type, location, frequency, and methods of data collection
- Evaluation of data sets and sampling designs to determine whether existing monitoring is meeting the needs of park managers and providing reliable and credible data to help manage estuarine resources
- Evaluation of other programs monitoring estuarine water quality and related variables inside and adjacent to parks by neighboring agencies, with the purpose

of determining where comparable data sets and sampling protocols exist and identifying potential monitoring partnerships (e.g. Environmental Monitoring and Assessment Program, National Estuarine Research Reserve System, state agencies)

- Prioritized list of candidate variables for monitoring effects of nutrients on estuarine water quality, and the basis for selection of those variables
- Identification of the subsequent tasks needed to develop an operational monitoring plan based on candidate variables. E.g., recommendations for field tests or other research needed to prioritize potential monitoring variables, determine appropriate sampling scales, etc.

Existing Relevant Programs

Cape Cod National Seashore Prototype Monitoring Program

Cape Cod National Seashore is the NPS “prototype” monitoring park for the Atlantic and Gulf Coast biogeographic region. Long-term monitoring protocols are being designed and tested for each major ecosystem type, including estuaries, and are expected to have direct application at other coastal parks in the region. Protocol development has emphasized the relevance of monitoring data to management goals related to the primary threats to ecosystem integrity.

The Cape Cod estuarine monitoring protocol is focused on detecting changes in nutrient inputs to estuaries and the ecosystem responses to these changes. The primary threats to water quality consist of increasing residential development and associated septic systems, fertilizer application, and runoff, and atmospheric deposition of nitrogen. Monitoring variables under investigation include sources of nutrient loading to estuaries and estuarine responses. Groundwater nutrient inputs (load and concentration) are monitored using seepage chambers, atmospheric nitrogen deposition is monitored at a National Atmospheric Deposition Program site within the Seashore, and changes in land use patterns are assessed from conversion of summer residences to year-round status, municipal water use, and land use/zoning surveys. Response variables consist of water quality constituents and characteristics (inorganic nutrients, chlorophyll a, light attenuation, temperature, and salinity), dissolved oxygen, macroalgal biomass and species composition, nitrogen content of *Enteromorpha*, aboveground eelgrass biomass, and distribution of major habitat types (eelgrass, macroalgal beds, marsh, etc.).

Test results are currently being evaluated to determine the suitability of individual variables for incorporation in a long-term monitoring program. Charles Roman reported that a draft protocol is expected within about 6 months.

Manual of Estuarine and Coastal Water Quality Protocols

Veronica Berounsky is preparing a manual for NPS on measuring estuarine and coastal water quality. These protocols will serve as guidance for NPS Level I water quality inventories. The manual includes background information and a conceptual basis for water quality measurement, methods for sampling water quality constituents, and recommendations on scale and frequency of measurement.

The manual is in final stages of editing. The information it contains is highly relevant to monitoring effects of nutrient enrichment in estuaries; both the framework for nutrient measurement and the methodology will likely be directly applicable to an estuarine monitoring protocol.

Environmental Monitoring and Assessment Program

EPA's Environmental Monitoring and Assessment Program (EMAP) has been collecting data from estuarine and coastal environments since the early 1990's. The geographic extents of several EMAP components coincide to varying degrees with the NPS Coastal and Barrier Network. Estuarine sampling has occurred within EMAP's Virginian Biogeographic Province (Cape Henry to Cape Cod), EPA's Region 2 (Regional-EMAP studies of NY/NJ Harbor and DE/MD coastal bays), and northeastern and mid-Atlantic coastal states (Coastal 2000 program). Monitoring variables include indicators of water quality, sediment chemistry and toxicity, and invertebrate and fish community status. Norm Rubinstein is currently examining EMAP programs to determine the utility of the data to network parks. EMAP sampling approaches may also be relevant to NPS estuarine monitoring.

EPA Research on Nutrient Loading and Ecological Response

Jim Latimer reported on a new EPA research program to develop nutrient load-response relationships for east coast estuaries. Initial efforts focus on evaluating a suite of variables from ca. 30 sites in southern New England representing a gradient of nutrient inputs. Assessment variables include characteristics of submersed aquatic vegetation (SAV: distribution, biomass, species composition, physiological condition), the water column (dissolved oxygen, chlorophyll a, phytoplankton size and species composition, extent of algal blooms), and the sediments (organic carbon, redox potential discontinuity layer). Results of this program will provide some regional tests of potential variables for long-term estuarine monitoring.

NPS Water Quality Monitoring

Brian Sturgis oversees a water quality monitoring program at Assateague Island National Seashore. A comprehensive suite of water quality characteristics is measured monthly at 18 stations. This data record should be consulted in selecting variables for monitoring throughout the network. In addition, SAV distribution is mapped annually through the Chesapeake Bay SAV Monitoring Program. No other park in the network has as extensive a water quality monitoring program.

Selection of Candidate Monitoring Variables

The workgroup will meet again in 6 months to select candidate variables for monitoring estuarine nutrient enrichment. This time frame will allow the group to draw from results of the Cape Cod prototype monitoring protocol and the assessment of individual park needs and existing data sets. Broad areas of consideration include measure(s) of nutrient sources, water

quality characteristics including dissolved oxygen, seagrass/macroalgal responses, and watershed land use.

Next Steps

The workgroup's report on candidate variables will identify any research needs for developing a network monitoring program. At a minimum, tests may be required to determine the suitability of certain variables for regional application, their natural spatial and temporal variability, and the appropriate sampling frequency and locations. Research may also be required to quantify responses of certain variables to changes in nutrient input and to define relationships to specific nutrient sources. The workgroup noted promising variables in need of more extensive field verification, including eelgrass density, leaf elongation rate, and shoot:root/rhizome ratio (see evidence from MERL experiments summarized in Nixon et al., In Press), biomass of macroalgae wherever it occurs (as opposed to random sampling), $\delta^{15}\text{N}$ of groundwater and surface water sources and estuarine biota as an indicator of wastewater nitrogen inputs, and eelgrass leaf nitrogen content in relation to area-specific leaf mass (Short et al., In Progress). Following completion of the synthesis report on candidate monitoring variables, the workgroup will guide any necessary field tests and oversee preparation of an operational monitoring plan for estuarine nutrient enrichment.